## Chapter 5.1 GROUND WATER PROTECTION PROGRAMS

The 1990 Census estimated that 1.4 million Virginians depended on ground water as the sole supply for their domestic water. Approximately 8 out of every 10 Virginians use ground water from public water supplies, private wells or springs for at least part of their daily water supply. While Virginia's ground water is generally of good quality, both the quality and quantity can vary across the five physiographic provinces found in the state.

General ground water quality information by physiographic province:

Cumberland Plateau
Geology: Sedimentary rock yielding ground water of varying quality
Pollution Potential: Moderate

The Cumberland Plateau province, encompassing the Southwestern tip of Virginia, is underlain by sedimentary rocks, principally sandstone, shale, and coal. Ground water quality here varies with depth. The first 100 feet of rock below stream level is often of poor quality, tending to be sulfurous and iron-rich, and naturally saline waters occur at depths greater than 300 feet. Better quality water can be found at depths of 150 to 300 feet below stream level, however. In coal mining areas, some ground water has become acidic due to mine drainage and is usually unsuitable for most uses.

Valley & Ridge
Geology: Sedimentary rocks including limestone, dolomite, and shale
Pollution Potential: High in limestone areas where ground water moves rapidly

Consolidated sedimentary rocks deposited beneath ancient seas underlie the Valley and Ridge Province to the west of the Blue Ridge. In the lowlands, such as the Shenandoah Valley, limestone and dolomite occur beneath the surface forming the most productive aquifers in Virginia's consolidated rock formations. In contrast, sandstone and shale are the rock types often present in the ridges and upland areas, which yield only enough water for rural and domestic supplies.

The connection between ground water and surface water plays a major role in ground water recharge in the Valley and Ridge, where streams often cross fault zones recharging aquifers. Wells in the fault zones have the greatest yields. Recharge also occurs through surface run-off into limestone sinkholes, bypassing filtration through the soil. This can cause serious water quality problems since polluted surface water may be introduced directly into the ground water system. Ground water quality can also be adversely affected by private trash dumps located in sinkholes that receive surface run-off. In addition, carbonate formations contribute to the "hardness" of the ground water.

The karst limestone type of terrain in the valley poses difficult problems for wellhead protection area delineation since underground conduits may act much like surface rivers. Some studies have suggested that surface water drainage patterns may be the best way to delineate wellhead protection areas in such circumstances.

Blue Ridge
Geology: Impervious rock. Well yields are low
Pollution Potential: High, because of rapid movement of water in cracks and fissures

The Blue Ridge Province is a relatively narrow zone to the west of the Piedmont, from 4 to 25 miles wide, with mountains of some of the highest elevations in the state. Beneath a thin layer of soil and weathered rock lies the bedrock, a relatively impervious zone containing water primarily in joints, fractures, and faults. On the eastern flank of the Blue Ridge, igneous and metamorphic rocks are most common while sedimentary rocks are more common on the western flank. Steep terrain and thin soil covering result in rapid surface run-off and low ground water recharge.

There has been little residential or industrial development in the Blue Ridge itself, so ground water use has been mainly for domestic needs rather than for public wells. The lower slopes of the mountains are the most favorable areas for ground water accumulation. Springs are common and are often used for private water

supplies. Because the rocks in the Blue Ridge are relatively insoluble, the ground water is not severely mineralized but iron content is high in some locations.

Piedmont
Geology: Diverse geology with a wide range of ground water quality and availability
Pollution Potential: Low to moderate

The largest physiographic province in Virginia is the Piedmont, extending from the fall line on the east to the Blue Ridge Mountains in the center of the state. Hard, crystalline igneous and metamorphic formations dominate this region with some areas of sedimentary rocks and saprolite deposits overlying the bedrock. The size and number of fractures and faults in the bedrock which store and transmit ground water decrease with depth, so most significant water supplies are found within a few hundred feet of the surface. Fairly large yields of water can be obtained where fracture and fault systems are extensive such as the Western Piedmont along the base of the Blue Ridge Mountains.

The diversity of the subsurface geology of the Piedmont Province results in wide variations in ground water quality and well yields, with ground water use at many locations limited. A few areas, for example, have problems with high iron concentrations and acidity. Because of the range in ground water quality and quantity in this region, as well as the subsequent varying potential for contamination, well site evaluation and well monitoring is very important here. From a wellhead protection standpoint, assumptions about the porosity and permeability of the overlying saprolite may have to be made so that reasonable estimates of wellhead protection areas can be calculated.

Coastal Plain
Geology: Unconsolidated sand, clay, marl, and shell strata. Groundwater is abundant and use is high.
Pollution Potential: High, due to geology and population density

The Coastal Plain in Virginia extends inland from the coast about 110 miles to the fall line and passes roughly through Fairfax County, Fredericksburg, Richmond, Petersburg, and Emporia. The Eastern Shore is part of this region and the two counties there have been conducting studies for several years to develop a more detailed understanding of their ground water situation. The Coastal Plain region is the only one in Virginia that is composed mostly of unconsolidated deposits, primarily alternating layers of sand, gravel, shell rock, silt, and clay. More ground water is stored in these very permeable materials than in any other province in the state. The pollution potential in the uppermost unconfined aquifer is high because of the permeability coupled with the high population density and agricultural activities in the area.

A large portion of the state's ground water use occurs in the Coastal Plain, which has two separate ground water systems, one shallow and one deep. In many places, a shallow unconfined aquifer system lies above relatively impermeable clay beds and is the source of water for hundreds of domestic and other small capacity wells. The principal source of major ground water withdrawals is a deeper system of confined aquifers. The recharge area to these aquifers occurs miles away where the formations outcrop but infiltration from the water table and shallower confined aquifer also recharge the deeper confined aquifers and could carry pollutants into these deeper reaches. The coastal plain presents a complex wellhead protection problem where the deep confined aquifers are concerned. The shallower aquifer, however, may have a more direct interaction with the surface and present a relatively straightforward challenge.

Except for areas where saltwater, iron, and hydrogen sulfide occur, the natural water quality in the Coastal Plain aquifers is good. In aquifers near a salt water interface, salt water may migrate west as aquifers are pumped. As a result, water from the deep aquifers on much of the lower York-James Peninsula and the Norfolk-Virginia Beach area generally contains high chloride concentrations, rendering the water too salty for domestic use without treatment.

## Office of Ground Water Characterization (OGWC)

During the 2005 session, the General Assembly passed legislation and provided funding to establish water supply and ground water characterization programs within DEQ in response to negative impacts experienced by many localities, businesses, and domestic well users during the drought of 2002.

The Commonwealth is divided into three regions to include the Coastal Plain, Piedmont-Blue Ridge,

and Valley-Plateau. The organizational objective of the Office of Ground Water Characterization is to protect Virginia's environment and promote the health and well being of its citizens by collecting, evaluating, and interpreting technical information necessary to manage ground water resources of the Commonwealth. OGWC staff will assure that necessary information is available to support resource management decisions, water supply planning activities, ground water availability, drought monitoring, and support the expansion or creation of ground water management areas.

Initial efforts will include cooperation with other state and federal agencies involved with ground water related activities to compile historical water well construction, withdrawal data, and water quality data into a GIS database as well as develop procedures to automate the acquisition of new data. Long range goals include expansion of the State Observation Network west of the fall line and publication of regional ground water resources reports.

*Regional Ground Water Reports*

During the late 1970s and early 1980s, State Water Control Board (SWCB) geologists compiled 18 ground water resources reports to document the availability, utilization rates, and water quality of ground water resources within selected counties and political sub-regions of Virginia. To date, the State Water Control Board ground water resource reports are the only readily available source of information pertaining to the occurrence, movement, and availability of ground water for a large number of the areas initially investigated. Although the majority of these historical reports are out of print, the reports will be made available on line on the DEQ Office of Groundwater Characterization web-site which is currently under development.

In addition to the State Water Control Board Ground Water Resources Reports, the OGWC is compiling recent and historical ground water and geologic data from multiple databases and water resource investigations into three regional reports intended to document the occurrence, movement, and availability of ground water within Virginia. The regional report format for inventorying ground water resources will address those portions of the state that were previously uninvestigated by the State Water Control Board and will present Virginia ground water resources based on regional and sub regional ground water flow systems rather than political boundaries. These reports will document and describe the geologic controls on the occurrence, movement, and availability of ground water in the State of Virginia, and will summarize current ground water extraction rates and trends. These reports will be made available to the public via the OGWC web site (under development), and are intended to be of greatest use to State and Municipal planners, consultants, and interested citizens.

*Statewide Well Construction Database*

Since each ground water geologist is charged with characterizing the ground water framework of extremely large regions, initial efforts have concentrated on the construction of a state-wide water well construction and water quality database. Over the years, water well information has been collected by different state and federal agencies for a variety of purposes. Prior to the adoption of the Groundwater Act of 1973 (Chapter 3.4 of Title 62.1, Waters of the State, Ports and Harbors), collection and submission of water well reports was largely a voluntary effort. Agencies such as Virginia Division of Mineral Resources, Virginia Division of Water Resources, Virginia Department of Health (VDH), and Virginia State Water Control Board had their own versions of water well reports and collected them for different purposes.

Water Well Completion Reports (WWCR), also known as GW-2 forms, is a requirement of the Groundwater Act of 1973, and they were required to be submitted to the SWCB. The SWCB collected and digitized approximately 22,000 wells and springs throughout the state from approximately 1968-1991. During this period, SWCB staff obtained well coordinates manually from 7.5' USGS topographic quadrangles. Well construction, location, and some water quality information was initially transferred onto paper punch cards and uploaded into EPA's STORET database. By the early 1980s, data was entered into STORET via remote computer terminals.

With the adoption of VDH's Private Well Regulations [12 VAC 5-630-10 through 480] (effective September 1, 1989), responsibility for collection of WWCR was transferred from the SWCB to the local health departments. In the past few years, local health departments have begun to enter private well information into a database called VENIS and have acknowledged the importance of coordinates on well records. VDH is in the process of revising private well and septic regulations and hopes to include GPS locations as a

requirement. Unfortunately, local health departments are not entering well construction information into VENIS and currently have no plans to do so in the near future. An effort is underway by the Virginia Water Well Association and a firm called Groundwater Dynamics to distribute electronic groundwater well completion software called "Aquiport" to drillers around the state. DEQ and VDH are supportive of electronic submittal of WWCRs and are encouraging the distribution of this software to drillers and local governments.

Well completion reports for public supplies (>15 service connections or >25 individuals) have been collected by the VDH Office of Drinking Water since the mid 1960s. Location information and other data pertaining to the use of the public supplies for most have been entered into the EPA's State Safe Drinking Water Information System (SDWIS). It appears that use of this database will require additional searching at VDH to match the well completion report on record with the location information in SDWIS.

The United States Geologic Survey (USGS) maintains a Groundwater Site Information (GWSI) database of wells used in various historical and ongoing studies. Well construction, geologic, and other information exists for 7,022 wells in the Virginia portion of the database.

One of DEQ's goals is to merge the various sources of historical and new well information into one statewide database that can be used for regional analysis of ground water aquifer systems. Major challenges to this goal are that fact that each database has its own numbering or indexing system. Duplicate wells exist in the various databases. Duplicate wells may or may not reference the other numbering systems of the different databases. The various databases have varying degrees of location accuracy as some were obtained from topographic quads and others were obtained using global positioning systems. Efforts to sort, clean up, and merge this data are ongoing. Completion of the state-wide well construction data base is expected to be completed in State fiscal year 2009.

*Statewide Legacy Geochemical Database*

Upon completion of the Statewide Well Construction Database in FY09, the OGWC will begin compiling a master database of legacy ambient water quality data of waters from wells and springs throughout the Commonwealth. Ambient water quality data comprising this database originates from a number of Federal and State databases and includes major ion geochemistry and field parameters for approximately 13,000 geo-referenced wells and springs. When combined with location data, ambient water quality samples from wells and springs provide valuable information about the background concentrations of naturally occurring ionic constituents and field parameters of ground water flow systems. In addition to their value in delineating natural ground water flow systems, it is anticipated that these data will be used by municipalities, consultants, and state and federal agencies for a wide variety of applications such as determining the extent and magnitude of elevated ionic concentrations (above background levels) due to ground water contamination from anthropogenic sources, for predicting chemical and biological interactions due to the contamination of ground water, and for optimizing well placement to insure high quality drinking water for private residences and municipalities.

*Statewide Legacy Spring Database*

The OGWC is in the process of creating a statewide spring database. To date, spring locations are largely unmapped in most parts of the region and limited information is fragmented among DEQ, DCR, USGS, and VDMR about the location, discharge, and basic water quality of such waters. A comprehensive database of this basic information is necessary for any attempt to understand regional water resources in such complex terrains as the carbonate aquifers of western Virginia. This geospatial database will also have value to other programs in DEQ such as Pollution Response and Petroleum Storage Tanks that deal with subsurface contaminant transport. Working agreements, standardized forms and definitions are being developed by OGWC that will be used by field personnel in sister agencies such as DCR, and DMMR in order to multiply the rate of compilation of new springs into a central database of spring locations, morphology, discharge, and basic geo-chemistry.

*State Observation Well Program*

The DEQ collects data on ground water levels at 187 wells and the USGS collects data on ground water levels at 218 wells, with periodic water quality samples taken at 19 of those wells. Sixty-one of the wells in the DEQ/USGS observation well network have been converted to real time monitoring with levels

measurements captured once every 15 minutes and uploaded to the internet using satellite technology. Data for 353 of the wells in the DEQ/USGS observation well network are published in *Water Resources Data, Virginia, Volume 2: Ground water and ground-water-quality records*, which are cooperatively prepared annually by the DEQ and the USGS. The information provided by the research stations is important for monitoring drought conditions, determining when ground-water recharge actually occurs, and monitoring the effects of ground water withdrawal. Additionally, the ground water level data collected cooperatively by the DEQ and USGS contributes to a long-term Coastal Plain ground water modeling project.

The OGWC was recently allotted a limited amount of funds to be used in the expansion of Virginia's real-time state observation network (SOW) that is operated in cooperation with the U.S. Geological Survey Virginia Water Science Center (http://waterdata.usgs.gov/va/nwis/current/?type=gw). If these stations were distributed evenly throughout Virginia, there would be a density of one (1) monitoring station for every 701 miles$^2$ of the state. Most, however, are located in the coastal plain region of eastern Virginia (45 out of 61). Eight (8) real-time research stations are located in the Piedmont and eight (8) are currently located west of the Blue Ridge Mountains. Considerable effort is underway to establish a higher density of real-time monitoring wells west of Interstate 95.

In order to extend the limited funds available to the SOW expansion project, OGWC has attempted to work cooperatively with localities to identify and use existing wells no longer in use by the well-owner. This approach has had mixed results depending on the enthusiasm of the locality and the suitability of the abandoned well. Increased funding would allow for the installation of new wells in areas that are more suitable for long-term monitoring.

*Geochemical Sampling Program Development*

OGWC is currently developing an ambient water quality monitoring program to obtain geochemical data from existing and recently acquired wells in the USGS/DEQ observation well network. State Observation Wells will be sampled for major ionic constituents and basic field parameters. These data will be incorporated into the DEQ geochemical database. It is anticipated that approximately 12 wells will be sampled annually. Sampling protocol and procedures are expected to be completed by early 2008. OGWC staff is currently procuring sampling equipment. Sample collection should begin in 2008.

*EPA/DEQ/USGS Cooperative Studies*

DEQ continues to cooperate with the USGS on a multi-year effort to update and revise the hydrogeologic framework and the ground water flow models utilized to better manage the ground water resources of the Virginia Coastal Plain. The newly revised models for the Virginia's mainland Coastal Plain and Virginia's Eastern Shore will be delivered in late 2007. Additionally, the cooperative effort between DEQ and the USGS to update the hydrogeologic framework has resulted in the publication of an award winning Professional Paper #1731, The Virginia Coastal Plain Hydrogeologic Framework, coauthored by E. Randolph McFarland (USGS) and T. Scott Bruce (DEQ). The paper was recently made available online at http://pubs.usgs.gov/pp/2006/1731/pp1731_download.htm and a limited number of copies are expected to be published in late 2007. This report presents the results of a multiyear study done in cooperation with the DEQ, the USGS and the Hampton Roads Planning District Commission with funding provided through EPA Clean Water Act grant funds. The report presents an in-depth synthesis and new region-wide interpretation of information from the Chesapeake Bay impact crater studies and from other recent studies. The report also provides a timely revision and update of the hydrogeologic framework for the Virginia Coastal Plain that was developed during the USGS RASA program.

Currently, DEQ is using EPA Clean Water Act grant funds on a cooperative project between DEQ and the USGS to describe the chemical quality of ground water in the Virginia Coastal Plain in a manner that will facilitate sound water-resource management.

With advancement of a new regional understanding of the Virginia Coastal Plain aquifer system, effective management of the ground-water resource is further predicated on knowledge of its chemical quality. No comparable effort has been undertaken for over 13 years, during which a large amount of additional ground-water quality data have been generated from diverse sources but nowhere collectively summarized. Additionally, in light of the newly revised hydrogeologic framework, the distributions of dissolved chemical constituents are only meaningfully determined within the context of the current understanding of the aquifer

system. A contemporary analysis of ground-water quality is further needed to evaluate associated resource-management scientific needs and planning implications. Particularly, regarding assessment of the potential for saltwater movement, costly drilling and modeling efforts likely will be needed to address complex hydrologic conditions. In conjunction with the revised hydrogeologic framework and new ground-water flow model, a regional characterization of ground-water quality would enable the most effective design and implementation of future efforts by making full use of existing information. A USGS report will be published in FY 09.

**Ground Water Protection Steering Committee**

Ground water programs in Virginia strive to maintain existing high quality water through adopted statutes, regulations, and policies. Advancing ground water protection efforts is the goal of many state programs in numerous state agencies. In late 1986, an interagency committee was formed to stimulate, strengthen, and coordinate ground water protection activities in Virginia. The Ground Water Protection Steering Committee (GWPSC) continues to meet bi-monthly with representation from the following agencies:

Department of Environmental Quality (DEQ)
Department of Health (VDH)
Chesapeake Bay Local Assistance Department (CBLAD)
Department of Mines, Minerals, and Energy (DMME)
Virginia Polytechnic and State University (VPI&SU)
Department of Housing and Community Development (VDH&CD)
Department of Agriculture and Consumer Services (VDACS)
Department of Conservation and Recreation (DCR)
Department of General Services, Division of Consolidated Laboratories (DCLS)
Department of Business Assistance (DBA)
US Geological Survey (USGS)

The following paragraphs briefly describe ground water protection activities at member agencies. Information provided in Tables 5.1-1, 5.1-2, 5.1-3, 5.1-4 and 5.1-5 is presented for the Commonwealth as a whole. Budgetary constraints within the Commonwealth prevent coordinated data collection activities designed to characterize ambient ground water quality and changes to that quality over time on a statistically valid statewide basis.

*Source Water and Wellhead Protection Efforts*

Building grassroots support for ground water and wellhead protection continue to be priorities of the GWPSC and its member agencies. VDH met their obligations for source water assessments as outlined in the 1996 Amendments to the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA). These assessments offer a reasonable starting point for protection activities. In the fall of 2004, DEQ completed a Wellhead Protection Plan for the Commonwealth and submitted it to EPA for approval. DEQ elected to move forward with the submittal of an EPA approved wellhead protection program with the expectation of leveraging funds from the SDWA to assist localities in implementation of local plans. The plan received EPA approval in May 2005. VDH and DEQ are cooperating on a new program that offers competitive grants to local governments with ground water based public water supplies. The funding sources are the Clean Water Act Section 106 Ground Water Protection Grant and the Safe Drinking Water Act Drinking Water State Revolving Fund Set-Asides. Additional information can be found at http://www.deq.virginia.gov/gwpsc/whp.html including information on funding opportunities.

**Table 5.1-1** Public Water Supply Systems and Population Served from Virginia's Source Water Assessment and Protection Reporting (as of Oct 4, 2007)

| | |
|---|---|
| Total Number of Public Water Supply (PWS) systems | 3,009 |
| Total Number of GW-Dependent PWS Systems | 2,680 |
| Total Number of Community Water Supply Systems | 1,243 |
| Total Number of GW-Dependent Community Water Supply Systems | 924 |
| Total Population Relying on Community Water Supply Systems | 6,433,814 |

| | |
|---|---|
| Total Population Relying on GW-Dependent Community Water Supply Systems | 501,228 |
| Total Number of GW-Dependent Non-Transient Non-Community PWS Systems | 567 |
| Total Number of GW-Dependent Transient Non-Community PWS Systems | 1,189 |

*Ground Water Management Act of 1992*

The 1992 session of the Virginia General Assembly adopted the Act and repealed the Ground Water Act of 1973. The Act establishes criteria for the creation of ground water management areas and requires entities that withdraw more than 300,000 gallons of ground water per month to obtain permits. The Act also requires previously exempted agricultural ground water withdrawals to obtain ground water withdrawal permits. The DEQ adopted regulations to implement the Act effective September 23, 1993 and amended January 1, 1999. This regulation includes specific requirements for agricultural ground water withdrawal permits and requires DEQ to perform technical evaluations of those proposed withdrawals.

*Storage Tank Compliance Program*

The Registration Program tracks ownership and technical information for 14,500 owners of 86,500 Underground Storage Tanks (USTs) and Aboveground Storage Tanks (ASTs) at 28,000 facilities in the Commonwealth. Each year the Program receives over 2,000 registrations that report new tanks, tank closures, and amendments to existing tank information, such as changes of ownership. DEQ and the public use the registration information to determine the identity of persons responsible for pollution prevention measures and cleanup of releases.

The AST Compliance Program regulates AST facilities of 25,000 gallons or greater that store oil. Nearly 1.5 billion gallons of oil are stored in the 3,400 regulated AST facilities across the Commonwealth. Through facility inspections, the Program seeks to ensure that Virginia's AST facilities have measures in place to prevent releases and to respond quickly and effectively if releases occur.

The UST Compliance Program regulates USTs larger than 110 gallons that contain regulated substances, which include most petroleum products. Nearly 164 million gallons of regulated substances are stored in the 20,662 active USTs across the Commonwealth. Through tank inspections, the Program seeks to ensure that USTs in the Commonwealth have measures in place to prevent releases and to have immediate notice of actual releases.

On August 8, 2005, President Bush signed H.R. 6, the Domenici-Barton Energy Policy Act of 2005. In Title 15 of the Act are amendments to Subtitle I of the Solid Waste Disposal Act addressing the regulation of underground storage tanks (primarily petroleum). Based upon EPA guidelines, DEQ is developing regulations to address UST secondary containment, delivery prohibition and operator training requirements.

Existing State Water Control Law (§62.1-44.34:9(2) & (8)) requires DEQ to carry out its powers and duties with regard to underground storage tanks in accordance with applicable federal laws and regulations.

*Storage Tank Remediation Program*

The Remediation Program directs the investigation and cleanup of the petroleum contaminated sites managed by responsible parties. The DEQ ensures that appropriate emergency response, initial abatement measures, site investigation and site remediation are performed by the responsible party. The DEQ also authorizes activities eligible for reimbursement from the Virginia Petroleum Storage Tank Fund.

The DEQ will conduct investigation and cleanup of high-priority petroleum contaminated sites in instances where the responsible party is unknown or financially unable to undertake the required work. Through a number of contractors, the DEQ conducts emergency response, initial abatement measures, site investigation and site remediation.

The DEQ also provides immediate, interim, and permanent relief to individuals whose drinking water wells have been rendered unusable by petroleum contamination. Through a DEQ contractor, carbon filtration

units (CFUs) are installed and maintained on contaminated wells until a permanent solution is implemented. Permanent solutions typically include extension of an existing public water supply or installation of a new well free from petroleum contamination.

Almost 7,900 site cleanups were completed from January 2001 though December 2006. Average cleanup time and average cleanup costs per site are among the lowest in the nation.

*Office of Hazardous Waste Activities*

The DEQ's Office of Hazardous Waste implements the requirements for ground water monitoring and corrective action as specified by the Resource Conservation and Recovery Act (RCRA). Funding for the program activities comes from an EPA grant covering hazardous waste management activities such as permitting, closure and corrective action, as well as compliance and enforcement. The grant does not cover data collection, with the exception of quality control samples. All ground water data are collected by the hazardous waste facilities and their consultants and reviewed by staff for adherence to regulatory requirements.

The Resource Conservation and Recovery Act (RCRA) addresses ground water quality issues at permitted and un-permitted facilities that have land-based units for the treatment, storage and disposal of hazardous waste. Permitted sites have to meet strict operational requirements to eliminate or minimize the risk of impacts on human health and the environment. Permits include contingency requirements mandating clean-up in case of a release of hazardous waste. Un-permitted sites are sites where operation has ceased and the facility is in the process of removing and/or decontaminating contaminated media (closure), sites where a permit is about to be issued, or sites where RCRA Corrective Action is being undertaken under an Order or agreement with EPA. Because sites can change status from permitted to un-permitted and vice versa, the information in the RCRA Corrective Action category in Table 5.1-4 has been combined into one reporting metric including both permitted and un-permitted sites.

Information provided in Table 5.1-4 RCRA Corrective Action category was derived for the sites in Virginia's Corrective Action universe, as reported to EPA in the program's FY07 grant report dated October 26$^{th}$, 2006. 75 sites were identified as exhibiting or having the potential for impacts on human health and the environment and are in various stages of evaluation and, where applicable, site clean-up. The increased number of sites from the previous assessment reflects a broadening of program scope to include more sites with a lower likelihood for impact. Most facilities have more than one waste-management unit, and all units need to be evaluated for potential impacts and undergo remediation if necessary. Between 2001 and 2006, facilities performed site investigations at 57 of these sites. Most investigations are still ongoing.

By the end of 2006, some degree of ground water contamination was confirmed at 48 sites. In cases where ground water monitoring detects exceedences above applicable ground water protection standards (such as EPA's Maximum Contaminant Levels for drinking water), facilities are required to implement clean-up measures under a process called RCRA Corrective Action. In recent years, EPA and the states have added more tools to the corrective action process to facilitate clean-up at a faster pace. These tools include the Facility Lead program, options for interim corrective measures, interim milestones such as environmental indicators for ground water and human health, and procedures to determine when the corrective action process is complete. As shown in Table 5.1-4, the number of sites where ground water contamination has been contained has increased from 13 to 42 since the last report. The increase is due both to the more flexible clean-up process and to the additional effort to determine which sites have stabilized. Corrective action plans for interim and/or final measures to remediate impacted ground water have been developed for 25 sites. Some type of remedial measure has been installed at 22 sites and 6 sites have met their ground water clean-up goals, up from one site during the previous assessment.

*Office of Remediation Programs*

Included in Table 5.1-4 are ground water contamination statistics from the DEQ's Office of Remediation Programs (ORP). ORP consists of the Federal Facilities Restoration Program, Superfund Program, Voluntary Remediation Program, Site Assessment Program, and the Brownfields Program. The Federal Facilities Restoration activities include Department of Defense (DOD) installations (Army, Navy, Air Force, Defense Logistics Agency, and Formerly Used Defense Sites) and two NASA installations for a total of 58 installations. Currently 13 Federal Facilities are listed on the National Priority List (NPL) and there are 45

non-NPL sites. Base Realignment and Closure is occurring or has occurred at eight facilities. Federal funding from the Department of Defense supports the Federal Facilities Restoration program. The Superfund Program, funded with both Federal and State dollars, carries out activities required by law or legal agreements at 21 NPL sites. Four of these sites have now been cleaned up and delisted. The Voluntary Remediation Program (VRP) provides a mechanism for eligible participants to voluntarily clean up properties not mandated for remediation under existing environmental laws. This program serves as a mechanism for cleanup of Brownfields sites. There are currently 301 VRP sites that are potential candidates for clean up, formally in the program, or have been cleaned up under the program. EPA funding supports the Voluntary Remediation Program. The Site Assessment Program (SAP), supported by EPA, is designed to assess potential CERCLA sites for inclusion on the NPL. The DEQ's Brownfields Program, also supported by EPA, provides incentives to owners and/or developers of potential brownfield sites to promote the redevelopment and reuse of these underutilized properties. The Brownfields program has assisted with the successful redevelopment of over 50 sites in Virginia in the last three years. None of these five programs currently collect ground water quality data; however, they do receive and review data collected by outside sources. Once fully established, the SAP will collect groundwater information at potential hazardous sites via sampling of wells as well as direct push technologies.

*Pesticide Disposal Program*

The Virginia Department of Agriculture and Consumer Services (VDACS) have conducted a highly popular and successful Pesticide Disposal Program since 1990. Since the Program's inception, more than 1.3 million pounds of unwanted pesticides have been collected from agricultural producers, licensed pesticide dealers and commercial pest control firms, homeowners and golf courses. There is no cost to participants.

To administer the Program, Virginia is subdivided into five regions. A pesticide disposal program is conducted annually in localities within one of the regions. Once all five regions have been served, the program starts another cycle. The Pesticide Disposal Program requires participants to transport their unwanted agricultural and commercial pesticides to a central collection site where the hazardous waste disposal contractor packages the pesticides for eventual disposal. If a participant cannot safely containerize the unwanted pesticides for transport, the disposal contractor will make such arrangements.
The pesticide disposal program has benefited from a high level of interagency cooperation among the VDACS, DEQ, DCR, DCLS, and Virginia Cooperative Extension. Initial funding to support this program was pooled from Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Clean Water Act (Sections 319 Non Point Source and 106 Ground Water Protection) grants as well as the Office of Pesticide Services (OPS) program fees. Currently, the program is supported entirely by OPS program fees.

*Plastic Pesticide Container Recycling Program*

The Virginia Department of Agriculture and Consumer Services (VDACS) and Virginia Cooperative Extension (VCE) conduct an annual plastic pesticide container recycling program. Since its inception, the program has collected and granulated a total of 817,595 pesticide containers.

The Plastic Pesticide Container Recycling Program addresses a challenge for agricultural producers and custom applicators. Typically, pesticide applicators dispose of their empty, clean plastic pesticide containers by hauling them to the local sanitary landfill. Recycling is an environmentally responsible alternative for the disposal of properly rinsed plastic pesticide containers. Granulated chips are transported to recycling facilities and fabricated into items such as pallets, fence posts, field drain tiles and parking stops thus keeping them out of landfills and reducing the potential for contamination from improperly rinsed containers which have either been landfilled or disposed of improperly.

To participate in the Program, a locality must make application to VDACS and agree to collect, inspect and store the properly rinsed containers until granulation. In FY07, VDACS provided $1,875 per locality in reimbursement costs to participating localities to offset the cost of the program. This program is funded through OPS program fees.

*Pesticides and Ground Water Management Plan*

VDACS continues a cooperative relationship with other agencies each with varying types and degrees of water quality responsibility including: DEQ, DCR, VDH, Department of General Services - Division of

Consolidated Laboratory Service and DGIF, with a focus on the stewardship of pesticides applied in, or around, ponds, lakes, streams and rivers in Virginia. As the state lead agency for all aspects of the Federal Insecticide, Fungicide and Rodenticide Act, VDACS, through its Office of Pesticide Services (OPS), is responsible for ensuring the proper use of pesticides, registration of pesticides, certification of pesticide applicators and licensure of pesticide businesses. The OPS Enforcement and Field Operations unit provides the investigation and inspection resources for conducting the regulatory provisions of the Virginia Pesticide Control Act which includes monitoring, compliance, and reporting (of adverse findings for non-compliance with the water quality protection labeling requirements) as part of routine inspections and investigating all reports involving water quality including appropriate pesticide sampling and enforcement action when necessary. VDACS will continue to develop and conduct management programs to protect ground water resources from pesticide risks through the evaluation of specific pesticides, including activities designed to reduce or prevent ground water contamination from pesticides.

*Virginia Ground Water Festival*

The first State sponsored Ground Water Festival was held in September 2000 in Harrisonburg, Virginia. Since that time, sixth grade students from a variety of elementary and middle schools across the Commonwealth have attended the all day education event. These festivals are funded through a combination of Federal, State, and local funding. Local volunteers can be credited with continuing these festivals which promote water resource stewardship and ground water protection concepts in particular. A summary of festivals and the number of students attending the festival follows:

**2000**
Ground Water Festival held September 22, 2000 at Massanetta Springs Conference Center
383 Rockingham County sixth graders attended; DEQ hosted event

**2001**
Ground Water Festival held September 21, 2001 at Camp Kittamaqund
100 Northumberland County sixth graders attended; DEQ hosted event

**2002**
Ground Water Festival held September 19, 2002 at Breaks Interstate Park
180 Dickenson County sixth graders attended; DEQ hosted event

Ground Water Festival held September 20, 2002 at Camp Kittamaqund
100 Northumberland County sixth graders attended; event hosted by local volunteers

**2003**
Stewardship Virginia - Ground Water Festival and Water Monitoring Day held October 23, 2003 at Camp Brady Saunders
330 Powhatan County sixth graders; DEQ hosted event
(The two events scheduled for Camp Kittamaqund were canceled in 2003 due to Hurricane Isabel.)

**2004**
Ground Water Festival held September 23, 2004 at the Selu Conservancy
147 Floyd County sixth graders; event hosted by DEQ

Ground Water Festival held September 27, 2004 at Camp Kittamaqund
97 Northumberland County sixth graders attended; event hosted by local volunteers

Ground Water Festival held September 30, 2004 at Camp Kittamaqund
110 Lancaster County sixth graders attended; event hosted by local volunteers

Ground Water Festival held October 18, 2004 at Breaks Interstate Park
187 Dickenson County fifth graders attended; event hosted by local volunteers

Ground Water Festival held October 19, 2004 at Breaks Interstate Park
275 Buchanan County fifth graders attended; event hosted by local volunteers

**2005**

Natural Resources Festival held May 17 and 18, 2005 at Russell County Fairgrounds

318 Russell County sixth graders attended; event hosted by local volunteers

Ground Water Festival held October 3, 2005 at Breaks Interstate Park

187 Dickenson County sixth graders attended; event hosted by local volunteers

Ground Water Festival held October 4 and 5, 2005 at Breaks Interstate Park

274 Buchanan County sixth graders attended; event hosted by local volunteers

Ground Water Festival held October 4, 2005 at Camp Kittamaqund

93 Lancaster County sixth graders attended; event hosted by local volunteers

Ground Water Festival held October 5, 2005 at Camp Kittamaqund

108 Northumberland County sixth graders attended; event hosted by local volunteers

**2006**

Natural Resources Festival held May 23, 2006 at Russell County Fairgrounds

212 Russell County sixth graders attended; event hosted by local volunteers

Ground Water Festival held October 17, 2006 at Camp Kekoka

93 Lancaster County sixth graders attended; event hosted by local volunteers

Ground Water Festival held October 19, 2006 at Camp Kekoka

125 Northumberland County sixth graders attended; event hosted by local volunteers

Ground Water Festival held October 24, 2006 at Breaks Interstate Park

182 Dickenson County sixth graders attended; event hosted by local volunteers

Ground Water Festival held October 25 and 26, 2006 at Breaks Interstate Park

276 Buchanan County sixth graders attended; event hosted by local volunteers

*Ground Water Protection Program Conclusion*

Ground water programs in Virginia strive to maintain the existing high water quality. The Virginia Ground Water Protection Steering Committee (GWPSC), established in 1986, continues to meet bi-monthly as a vehicle for sharing information, for directing attention to important ground water issues, and for taking the lead on ground water protection initiatives requiring an inter-agency approach. This inter-agency advisory committee is designed to stimulate, strengthen, and coordinate ground water protection activities in the Commonwealth. Ground water protection activities in the Commonwealth are as varied as the funding sources that support them.

**Table 5.1- 2 Primary Sources of Ground Water Contamination**

| Contaminant Source | Ten Highest-Priority Sources(/) | Factors Considered in Selecting a Contaminant Source | Contaminants |
|---|---|---|---|
| Agricultural Activities | | | |
| **Agricultural chemical facilities** | | | |
| Animal feedlots | | | |
| Drainage wells | | | |
| Fertilizer applications | / | (F) State GW Protection Strategy | (E) |
| Irrigation practices | | | |
| Pesticide applications | / | (F) State GW Protection Strategy | (A,B) |
| Storage and Treatment Activities | | | |
| Land application | / | (F) State GW Protection Strategy | (E) |
| Material stockpiles | | | |
| Storage tank (above ground) | | | |
| Storage tank (underground) | / | (F) State GW Protection Strategy | (D) |
| Surface impoundments | / | (F) State GW Protection Strategy | (E) |
| Waste piles | | | |
| **Disposal Activities** | | | |
| Landfills | / | (F) State GW Protection Strategy | (M) 40 CFR-App IX |
| Septic systems | / | (F) State GW Protection Strategy | (J) |
| Hazardous waste generators | | | |
| Hazardous waste sites | | | |
| Industrial facilities | | | |
| Material transfer operations | | | |
| Mining and mine drainage | / | (F) State GW Protection Strategy | (M) Acid Leachate |
| Pipeline and sewer lines | | | |
| Salt water intrusion | / | (F) State GW Protection Strategy | (G) |
| Urban runoff | / | (F) State GW Protection Strategy | (M) NPS pollutants such as fertilizers & heavy metals |
| Other sources (please specify) | | | |

A-Inorganic Pesticides
B-Organic Pesticides
C-Halogenated Solvents
D-Petroleum Compounds
E-Nitrite
F-Fluoride
G-Salinity/Brine
H-Metals
I-Radionuclides
J-Bacteria
K-Protozoa
L-Viruses
M-Other

**Table 5.1-3 Summary of State Ground Water Protection Programs**

| Programs or Activities | Check* (/) | Implementation Status | Responsible State Agency |
|---|---|---|---|
| Active SARA Title III Program | / | fully-estab. | DEQ |
| Ambient ground water monitoring system | | | |
| Aquifer vulnerability assessment | / | under devel. | VDCR |
| Aquifer mapping | | | |
| Aquifer characterization | | | |
| Comprehensive data management system | | | |
| EPA-endorsed Core Comprehensive State Ground Water Protection Program (CSGWPP) | | | |
| Ground water discharge permits (VPA) | / | fully-estab. | DEQ |
| Ground water Best Management Practices | | | |
| Ground water legislation (Quantity) | / | fully-estab. | DEQ |
| Ground water classification | | | |
| Ground water quality standards | / | fully-estab. | DEQ |
| Interagency coordination for ground water protection initiatives | / | fully-estab. | DEQ |
| Nonpoint source controls | / | cont. efforts | VDCR |
| Pesticide State Management Plan (Generic) | / | fully estab. | VDACS |
| Pollution Prevention Program | | | |
| Resource Conservation and Recovery Act (RCRA) Primacy | / | fully-estab. | DEQ |
| Source Water Assessment Program | / | fully-estab. | VDH |
| State Superfund | | | EPA primacy |
| State RCRA Program incorporating more stringent requirements than RCRA Primacy | | | |
| State septic system regulations | / | fully-estab. | VDH |
| Underground storage tank installation requirements | / | fully-estab. | DEQ |
| Underground Storage Tank Remediation Fund | / | fully-estab. | DEQ |
| Underground Storage Tank Permit Program | / | fully-estab. | DEQ |
| Underground injection Control Program | | | EPA primacy |
| Well abandonment regulations | / | fully-estab. | VDH |
| Well Installation regulations | / | fully estab. | VDH |

**Table 5.1-4 Ground Water Contamination Summary**

Aquifer Description Commonwealth of Virginia

Data Reporting Period January 1, 2001 - December 31, 2006

| Source Type | Present in reporting area | Number of sites in area | Number of sites that are listed and/or have confirmed releases | Number with confirmed groundwater contamination | Contaminants | Number of site investigations (optional) | Number of sites that have been stabilized or have had the source removed (optional) | Number of sites with corrective action plans (optional) | Number of Sites with active remediation (optional) | Number of sites with cleanup completed (optional) |
|---|---|---|---|---|---|---|---|---|---|---|
| NPL | | 21 | 21 | 15 | (A) append 9 | 21 | 17 | 20 | 20 | 4 |
| CERCLIS (non-NPL) | | 200+ | | | | | | | | |
| Voluntary Remediation | | 301 | 290 | 250 | (A) & (B) | 230 | | | | 157 |
| DOD/DOE (NPL) _ (NPL) | | 13 | 202 | 164 | VOCs, SVOCs, metals, PCBs, mercury (B) | 150 | 67 | 32 | 36 | 104 |
| DOD/DOE(nonNPL) | | 23 | 115 | 84 | VOCs, SVOCs, metals, PCBs, mercury (B) | 68 | 23 | 9 | 9 | 22 |
| Leaking UST & AST as of DEC 2006 | | 24,614 | 24,614 | | petroleum hydrocarbons | | | | 1,692 | 22,922 |
| RCRA Corrective Action | PERMITTED (includes state and federal permits) and UNPERMITTED (closing, permit to be issued, or remediating under alternate mechanism | 75 | 60 | 48 | (A), (B), others | 57 | 42 | 25 | 22 | 6 |
| Underground Injection | | | | | | | | | | |
| State Sites | | | | | | | | | | |
| Nonpoint Sources | | | | | | | | | | |
| Other (specify) | | | | | | | | | | |

**Source Type** Abbreviations
NPL - National Priority List
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOE - Department of Energy
DOD - Department of Defense
LUST - Leaking Underground Storage Tanks
RCRA - Resource Conservation and Recovery Act

**Contaminant** Type
(A) listed and characteristic hazardous waste
(B) metals, halogenated organics, POL,PCB, Pesticides

**Table 5.1-5 Aquifer Monitoring Data**

Hydrogeologic Setting [1] Commonwealth of Virginia

Spatial Description (optional) [2] _NA_____

Map Available (optional) [3] __NA_____

Data Reporting Period [4] January 1, 2003 through December 31, 2006

| Monitoring Data Type | Total No. of Wells Used in the Assessment [5] | Parameter Groups | Number of Wells | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | No detection of parameters above MDLs or background levels | | Nitrate concentrations range from background levels to less than or equal to 5 mg/l<br><br>No detection of parameters other than nitrate above MDLs or background levels and/or located in areas that are sensitive or vulnerable | | Nitrate ranges from greater than 5 to less than or equal to 10 mg/l<br><br>Other parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs [10] | Parameters are detected at concentrations exceeding the MCLs [11] | Number of wells removed from service [12] | Number of wells requiring special treatment [13] | Background parameters exceed MCLs [14] |
| | | | ND [6] | Number of wells in sensitive or vulnerable areas (optional) [7] | Nitrate ≤5mg/l<br><br>VOC, SOC, and other parameters not detected [8] | Number of wells in sensitive or vulnerable areas (optional) [9] | | | | | |
| Finished Water Quality Data from Public Water Supply Wells | 2,103* | VOC | 5,736 | | | | | | | | |
| | | SOC [15] | 4,325 | | | | | | | | |
| | | $NO_3$ | 6,554 | | 12,688 | | | | | | |
| | | Other [16] | | | | | | | | | |

These numbers are provided by the Virginia Department of Health, Office of Drinking Water. Data is given for wells associated with mixed systems (surface and ground water) and ground water based systems. SOC data is limited due to waiver programs and no detections in systems that were monitored. VOC and SOC data may be incomplete due to optional data entry requirements in VDH field offices. MCL exceedence information required additional work that VDH staff limitations prevented. Software modernization efforts underway at EPA may make providing this information in future reports an easier task. Ambient data, Untreated Water Quality data from PWS, and unregulated well data is not collected or not available.

*VDH began chemical electronic reporting in January 2003. Therefore, the sample results data for this report are for 4 years instead of 6 years.*
**Total number of wells (2,103) is a subset of sample results for VOC, SOC, and NO. There may be multiple sample results for a single well.*